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REMARKS

In view of the above amendments and the following remarks, favorable reconsideration of the outstanding office action is respectfully requested.

Originally filed claims 2, 3, 6, 9, 10 and 15 remain in the application. Claims 1, 4, 5, 11-14, 16 and 18 are currently amended. Claims 7, 8, 17 and 19-21 are canceled without prejudice. Claim 22 is regarded as a canceled claim insofar as the originally filed claim 22 is renumbered as claim 21.

Applicant submits that no new matter has been introduced in the application by virtue of the above claim amendments.

The Examiner correctly pointed out that the originally filed claim 22 was misnumbered and should be numbered as claim 21. It appears from the Office action that the Examiner has been treating the originally filed claim 22 as claim 21. Thus in this response, Applicant has renumbered the originally filed claim 22 as claim 21.

1. Rejections under 35 U.S.C. § 112

I. Item 2 of the Detailed Action

In this item of the Detailed Action, the Examiner has rejected claim 7 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

Applicant has canceled originally filed claim 7 without prejudice.

2. Rejections under 35 U.S.C. § 102

II. Item 4 of the Detailed Action

In this item of the Detailed Action, the Examiner has rejected originally filed claims 1-3, 7-8, 11-12 and 15 under 35 U.S.C. § 102(b) as being anticipated by Eda (United States Patent No. 5,785,874).

The Examiner asserted, particularly with respect to claim 1, that:

Eda is directed to making an optical waveguide by directly bonding two silicon-containing (glass) substrates 2, 14 (Figure 14). Prior to bonding, the surface of each substrate is cleaned, contacted with an acidic solution (i.e. HF), contacted with a basic solution (i.e. ammonia/hydrogen peroxide), and contacted with pure water in this order (column 14, line 63-column 15, line 10). Therefore, the skilled artisan would have readily appreciated that the treated surfaces of Eda would have the presently claimed functional groups thereon.

Applicant respectfully traverses this rejection.

Column 14, line 63 to column 15, line 10 of Eda is reproduced as follows:

First, a surface of a substrate which is to be bonded with a glass substrate is sufficiently cleaned. The cleaned surface is then subjected to a hydrophilic treatment. When the support substrate is made of a dielectric such as lithium niobate and lithium tantalite glass, or an Si semiconductor, the surface of the support substrate can be made hydrophilic by slightly etching the surface using a hydrofluoric acid etchant and then immersing it in an ammonia/hydrogen peroxide solution. When the support substrate is a GaAs or InP semiconductor, the surface is made hydrophilic by a process similar to the above using, in this case, a sulfuric acid/hydrogen peroxide etchant for the etching of the surface. Thereafter, the support substrate is immersed in pure water to be cleaned. By this hydrophilic treatment, hydroxyl groups are generated on the surface of the support substrate and adsorb water molecules, making the surface highly hydrophilic.

Emphasis added.

Column 15, lines 22 to 26 of Eda provide that “[t]he above two hydrophilic surfaces of the support substrate and the low refractive index layer formed in the glass substrate are then attached to each other. They are bonded through direct bonding by the hydrogen bond among the hydroxyl groups and the adsorbed water molecules on the surfaces.”

Thus the relevant portions of Eda, reproduced above, do not disclose the termination groups on the opposing surfaces to be bonded as containing $\equiv\text{Si-OH}$, $=\text{Si-(OH)}_2$, $-\text{Si-(OH)}_3$, and/or $-\text{O-Si-(OH)}_3$.

The Examiner appears to have the view that the method as disclosed in Eda, as reproduced above, would lead to the formation of the groups $\equiv\text{Si-OH}$, $=\text{Si-(OH)}_2$, $-\text{Si-(OH)}_3$, $-\text{O-Si-(OH)}_3$.

Applicant respectfully disagrees to this point. It is submitted that the formation of groups $\equiv\text{Si-OH}$, $=\text{Si-(OH)}_2$, $-\text{Si-(OH)}_3$ and $-\text{O-Si-(OH)}_3$ cannot be automatically achieved by contacting the surfaces with ammonia/peroxide. Sufficient contacting time is required for such effect. Eda does not disclose the $\text{NH}_3/\text{H}_2\text{O}_2$ etching time. The Eda process requires the use of HF as the acid etchant. The process of claim 1 of the present application does not require the use of HF. For example, nitric acid solution can be used in the process of claim 1. This constitutes a difference between the disclosed process of Eda and claim 1 of the present application as well. It is unclear whether the $\text{NH}_3/\text{H}_2\text{O}_2$ solution used in Eda is acidic or basic. Applicant submits that H_2O_2 aqueous solution is slightly acidic. Thus the mixture of $\text{NH}_3/\text{H}_2\text{O}_2$ in Eda, absent a description of concentration, may have a pH less than 8. The hydroxyls as disclosed in Eda could be those of the H_2O molecules adsorbed to the surfaces, instead of those directly bonded to Si. This theory is somewhat bolstered by the fact that according to the relevant parts of Eda, reproduced supra, the process is equally applicable for materials not containing Si, such a lithium niobate and lithium tantalite glasses.

Therefore, it is Applicant's view that Eda fails to disclose, impliedly or explicitly, all limitations of claim 1, as amended herein. Hence, claim 1, as amended, is not anticipated by Eda.

Claims 2-3, 7-8, 11-12 and 15, as amended, all dependent from claim 1, are not anticipated by Eda, accordingly.

3. Rejections under 35 U.S.C. § 103

III. Items 6 of the Detailed Action

In this item of the Detailed Action, the Examiner rejected claims 4 under 35 U.S.C. § 103(a) as being unpatentable over Eda in view of Landrock (Adhesives and Technology Handbook).

Applicant respectfully traverses this rejection.

First, it is Applicant's view that claim 1 is not obvious over the teaching of Eda in view of Landrock.

Applicant respectfully submits that the combination of Eda and Landrock do not establish a prima facie obviousness case of claim 1.

With regard to the Examiner's duty of establishing a prima facie obviousness case in the Office Action, the MPEP provides:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

MPEP, 2142, Eighth Edition.

As discussed supra, Eda does not disclose, explicitly or implicitly, the formation of groups $\equiv\text{Si-OH}$, $=\text{Si}-(\text{OH})_2$, $-\text{Si}-(\text{OH})_3$ and/or $-\text{O-Si}-(\text{OH})_3$ on opposing surfaces. The combination of Eda and Landrock does not disclose the formation of these groups, either.

Even assuming, arguendo, that a prima facie obviousness case could have been established by the combination of Eda and Landrock, which they cannot, such case is rebutted for the following unexpected technical results.

Applicant believes that the formation and existence of these groups lead to an easier and better bonding between the surfaces.

As discussed supra, the hydroxyls as mentioned in the relevant portions of Eda, reproduced supra, may be solely those of the H₂O molecules adsorbed onto the surfaces of the glasses. And the bonding of the surfaces as disclosed in Eda could be only the result of hydrogen bonding.

However, according to the present invention, because the groups $\equiv\text{Si-OH}$, $=\text{Si-(OH)}_2$, $-\text{Si-(OH)}_3$ and/or $-\text{O-Si-(OH)}_3$ are provided as terminal groups on the opposing surfaces to be bonded of the silicon-containing articles, the bonding between the surfaces involve the hydroxyls in these groups. Direct covalent bonds are formed between the surfaces, especially after an optional step of removing water between the two surfaces. As is well known, covalent bonds are stronger than hydrogen bonds. Thus, the bonding formed between the surfaces according to the processes of the present invention is stronger.

Among all groups $\equiv\text{Si-OH}$, $=\text{Si-(OH)}_2$, $-\text{Si-(OH)}_3$ and $-\text{O-Si-(OH)}_3$, $\equiv\text{Si-OH}$ has the least steric movement, $=\text{Si-(OH)}_2$ has more, $-\text{Si-(OH)}_3$ has even more, and $-\text{O-Si-(OH)}_3$ has the most steric movement. OH groups are able to rotate and pivot at their bond site to the silicon atom. For $-\text{O-Si-(OH)}_3$ the silicon atom pivots and rotates at its bond site, and the root oxygen atom pivots and rotates around the bond site, providing more steric movement for the OH groups than $-\text{Si-(OH)}_3$. When two opposing surfaces are brought into contact, each surface has a specific concentration of active surface sites. These sites do not perfectly align with one another when the surfaces are contacted. Bond strength can be described in terms of the number of bonds that are allowed to form. For termination sites that do not perfectly align, steric movement can allow two termination sites to bond across a lateral distance. The present invention, therefore, in certain embodiments, by providing the groups $=\text{Si-(OH)}_2$, $-\text{Si-(OH)}_3$ and/or $-\text{O-Si-(OH)}_3$, which are larger and have more steric movement, and thus the capability of forming more bonds between the opposing surfaces, has the advantage of better bonding for the same surfaces, and of allowing for bonding over greater distances for surface sites that do not perfectly align. Furthermore, flatness and conformity between the surfaces is critical. The larger the termination group, the further from the surface it extends. Thus the process of claim 1 of the present application allows for more bond sites and thus a better bonded interface for surfaces that do not perfectly conform.

Therefore, claim 1 is non-obvious over Eda further in view of Landrock.

Claim 4, dependent from claim 1, is not obvious over Eda further in view of Landrock, accordingly.

V. Item 7 of the Detailed Action

In this item of the Detailed Action, the Examiner rejected claims 5 and 6 under 35 U.S.C. § 103(a) as being unpatentable over Eda and Landrock as applied to claim 4 above, and further in view of Shiono et al. (P2000-56265A).

For substantially the same reasons outlined supra against the rejection of claim 4, this rejection is traversed.

VI. Item 8 of the Detailed Action

In this item of the Detailed Action, the Examiner rejected claim 9 under 35 U.S.C. § 103(a) as being unpatentable over Eda and Landrock as applied to claim 4 before, and further in view of Rangsten et al. (Journal of the Electrochemical Society).

The Examiner asserted that “Eda is silent as to the acidic solution being HNO₃. Selection of a particular acidic solution would have been within the purview of the skilled artisan depending on the type of silicon-containing substrate used, as suggested by Eda (column 15, lines 1-8).”

For substantially the same reasons outlined supra against the rejection of claim 4, this rejection is traversed.

In addition, Applicant submits that Eda does not suggest the selection of a different acidic solution for different types of silicon-containing substrate used. The disclosure of lines 1-8 of column 15 of Eda concerns with two different substrates, one that may contain silicon (a dielectric), and the other that does not contain silicon (GaAs or InP semiconductor). Eda specifically discloses that for the first category of substrate, hydrofluoric acid is used. Eda does not provide a possibility of alternative acid for these materials that may contain silicon. It is related to the GaAs or InP semiconductor, which does not contain silicon at all, that Eda provides a different acid/H₂O₂ combination to replace the HF etch and NH₃/H₂O₂ etch combination. It is known that HF is highly reactive with Si-containing glasses. However, HNO₃ is not. Thus it is not obvious for an artisan of ordinary skill in the art to replace HF as taught by Eda with HNO₃ of claim 9 of the present application. Moreover, avoiding the use of HF, which is highly toxic, indeed constitutes a technical advantage of the process of the present invention.

Rangsten et al. does not teach the use of the combination of nitric acid and basic solutions in processing the surfaces. It appears the teaching of Rangsten et al. regarding the use of HNO₃ was intended, at least in part, for the stripping of the Cr/Au film deposited on the wafer surfaces.

VII. Item 9 of the Detailed Action

In this item, the Examiner rejected claim 10 under 35 U.S.C. § 103(a) as being unpatentable over Eda, Landrock, and Rangsten et al. as applied to claim 9 above, and further in view of Shin et al.

In her rejection, the Examiner asserted that “Eda is silent to the basic solution being one of those claimed in the present invention. Selection of a particular solution would have been within the purview of the skilled artisan depending on the type of silicon-containing substrate used, as suggested by Eda (column 15, lines 1-8).”

For substantially the reasons outlined supra against the rejection of claim 4, this rejection is traversed.

In addition, Applicant submits that Eda does not suggest the selection of different basic solutions for different types of silicon-containing substrate used. The disclosure of lines 1-8 of column 15 of Eda concerns with two different substrates, one that may contain silicon (a dielectric), and the other that does not contain silicon (GaAs or InP semiconductor). Eda specifically discloses that for the first category of substrate, NH₃/H₂O₂ solution is used. Eda does not provide a possibility of alternative basic solution for these materials that may contain silicon. Moreover, as submitted by Applicant, supra, whether the H₂O₂/NH₃ solution as used in Eda is acidic or basic is subject to doubt. It is related to the GaAs or InP semiconductor, which does not contain silicon at all, that Eda provides a different acid/H₂O₂ combination to replace the HF etch and NH₃/H₂O₂ etch combination. Indeed for this substrate containing GaAs or InP semiconductor material, Eda does not teach the use of a basic solution to etch it at all.

VIII. Item 10 of the Detailed Action

In this item, the Examiner rejected claim 13 under 35 U.S.C. § 103(a) as being unpatentable over Eda as applied to claim 12 above, and further in view of Sayah et al. (Sensors and actuators).

For the reasons outlined supra against the rejection of claim 4, claim 1 is not obvious over Eda. The Examiner's grounds for rejecting claim 13, in combining Eda and Sayah, even assumed to be correct, does not negate the conclusion that claim 1 is not obvious. Thus, claim 13, dependent from claim 1, is not obvious over Eda and Sayah under 35 U.S.C. § 103(a).

IX. Item 11 of the Detailed Action

In this item, the Examiner rejected claim 14 under 35 U.S.C. § 103(a) as being unpatentable over Eda as applied to claim 11 above, and further in view of Ramsey et al. (United States Patent No. 6,129,854).

For substantially the same reasons outlined supra against the rejection of claim 12, this rejection is traversed.

X. Items 12-15 of the Detailed Action

In these items, the Examiner rejected claims 15-21 as originally filed under 35 U.S.C. § 103(a) as being unpatentable over Eda in view of Landrock, Shiono et al. and Vines et al. (United States Patent No. 6,429,144), and/or Sayah et al., Rangsten et al., and Shin et al.

The Examiner is requested to note that claim 16, as amended herein, incorporates the limitations of originally filed claims 17, 19 and 20, which are now canceled without prejudice.

Applicant submits that, for reasons outlined supra, the references do not teach or suggest all of the limitations of claim 16, as amended, contrary to the Examiner's assertions.

XI. Items 16 and 17 of the Detailed Action

In these two items, the Examiner rejected originally filed claim 16 of the application under 35 U.S.C. §103(a).

Applicant submits that since the rejections were not made against originally filed claims 19 or 20, they are no longer applicable for claim 16 as amended herein.

4. Double Patenting Rejection

XII. Item 18 of the Detailed Action

In this item, the Examiner rejected claims 1-21 of the present application for double patenting. The Examiner asserted that claims 1-21 conflict with claims 1-21 of Application No. 10/255,926. The Examiner further required Applicant either to cancel the conflicting claims from all but one application or maintain a clear line of demarcation between the applications.

Applicant respectfully submits that claims 1-21 do not conflict with claims 1-21 of Application Serial No. 10/255,926. The independent claims 1 and 16, as amended herein, are different from those of Application Serial No. 10/255,926. The Examiner's attention is directed to the $\equiv\text{Si-OH}$ group recited in claim 1 of the present application, which is not recited in claim 1 of 10/255,926. Claim 16 of the present application, as amended herein, recites a feature of heating the opposing surfaces to a temperature of less than 300°C, which is not recited in claim 16 of Application Serial No. 10/255,926.

XIII. Item 20 of the Detailed Action

In this item, the Examiner provisionally rejected claims 1, 3, 7 and 15 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 6-8, 10, 15-16, 24-26, 28, 36-38 and 41-46 of copending application Nos. 10/255,777 and 10/035,358.

The Examiner asserted that “[a]lthough the conflicting claims are not identical, they are not patentably distinct from each other because the claims of the copending application[s] encompass the limitations set forth in the present application.”

Applicant respectfully traverses this rejection.

Claim 1 of the present application clearly is directed to a process of bonding opposing surfaces of at least two silicon-containing articles. However, none of the claims of 10/255,777 and 10/035,358 as specified by the Examiner requires that the surfaces to be bonded are those of silicon-containing articles. Although some of these claims specify that the termination groups can be silicon-containing, it is not clear whether these termination groups are created by converting silicon contained in the articles or by introduction from an exiguous source, such as the solution having a pH over 8. Thus the Examiner’s sole ground for rendering this obviousness-type double patenting rejection that “the claims of the copending application[s] encompass the limitations set forth in the [relevant claims of] present application” cannot be sustained.

XIV. Items 21-32 of the Detailed Action

In these items, the Examiner rejected various claims provisionally under the judicially created doctrine of obviousness-type double patenting as being unpatentable over various claims of copending application Nos. 10/255,777, 10/035,358 and/or 10/035,659, in view of various further references discussed supra.

Applicant respectfully submit that these rejections were either traversed supra in connection with the discussion of those applications and/or references, or will be automatically overcome by claim amendments either in the present application or the relevant copending applications, and/or by filing terminal disclaimers. In case the Examiner insists on these rejections under the judicially created doctrine of obviousness in view of future amendments to and/or submission in these other applications, it is respectfully requested that the Examiner to consider allowing Application Serial No. 10/255,926 first, if it is ever in condition for allowance. The remaining double-patenting rejections in this and other applications will be addressed upon the grant of this application accordingly.

6. Conclusion

Based upon the above amendments, remarks, and papers of record, Applicant believes the pending claims of the above-captioned application are in allowable form and patentable over the prior art of record. Applicant respectfully requests reconsideration of the pending claims 1-6, 9-16 and 18 and a prompt Notice of Allowance thereon.

Applicant believes that a one month extension of time is necessary to make this Response timely. Should Applicant be in error and further time extension is required, Applicant respectfully requests that the Office grant such time extension pursuant to 37 C.F.R. § 1.136(a) as necessary to make this Response timely, and hereby authorizes the Office to charge any necessary fee or surcharge with respect to said time extension to the deposit account of the undersigned firm of attorneys, Deposit Account 03-3325.


The undersigned attorney is granted limited recognition by the Office of Discipline and Enrollment of the USPTO to practice before the USPTO in capacity as an employee of Corning Incorporated. A copy of the document granting such limited recognition is submitted herewith for the record.

Please direct any questions or comments to the undersigned at (607) 248-1253.

Respectfully submitted,

CORMING INCORPORATED

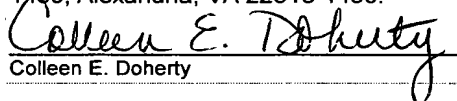
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Colleen E. Doherty